

Experimental Television Center: Keying  
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Keying Process

Matthew Schlanger c 1984 Experimental Television Center Studio Manual, 1980 and 1986

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Keying is a process in which two video signals, or lack of signals, are mixed in such away that a third signal is used as a reference to determine when and where the mix takes place. Recall that a frame is made up of 525 lines, which are divided into two fields, each containing 262.5 lines. One field traces out the even lines for a given field, then, after blanking, the next field traces out the odd lines for the same frame. In order to mix a number of video signals, we find it necessary to sync every vidicon tube, CRT, so that each electron gun is tracing out the same line at the same time. The keyer must also be synced, since it will be constructing a final signal, or image, whose lines correspond to those of the input signals'. This synchronized line tracing is accomplished with sync and blanking pulses. Each vidicon receives a blanking pulse to indicate when to stop tracing out a line, and to retrace. During the retrace period each camera then receives a horizontal sync pulse. Vertical blanking and sync take place between tracing out each field. In the interim, the camera is taking these light images and turning them into an electronic "video signal", line by line, field by field. A video signal is one volt, peak to peak, such that there exists a direct relationship between brightness and voltage. The brighter the piece of the image, the higher the voltage which correlates to that piece of image. The video signal, then, is a linear, line by line, change in voltage over time, which corresponds to the gray levels (or brightness) of each traced line.

In keying, one video signal is used as a reference to know when to switch from video signal "A" to "B". The reference signal is called the clip. One can choose se which of several signals will be used to clip with a clip "select" knob (or lever). What the keyer is doing is high-speed switching.

Let us take the example of external keying, where three video signals are used to produce one final video signal. The keyer has as inputs: the clip signal, and two other camera signals, lets call them "A" and "B".

With a "clip level", or "keying level" knob, one can select at which gray level, or voltage, the keyer will switch from A to B. The switching is done while each line is being traced. Since the

line frequency is 15,750 lines per second, and the keyer is switching several times along each line, we are given the right to call keying “high speed switching”.

Say we have chosen, with the use of the keying level knob, that .5 volts is the gray level we will use as the reference point, 'for the keyer to know when to switch from signal A to B. The keyer, then, is monitoring the clip signal, and switching to, say, A, for those values below our .5 volt clipping level, and switching to B for those values above the clipping level. Looking at that line by line, the keyer will trace out signal A until it reads a .5 or above voltage from the clip signal, at which time the keyer will switch to signal B. Each line is read simultaneously while the keyer switches from A to B according to the reference voltage chosen; switching at such time when that reference voltage appears in that clip signal. The final product will be a signal which is comprised of signal A, at every point below the chosen reference gray level, of the clip; and comprised of signal B, at every point above the chosen gray level of the clip.

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### III. KEYERS

Keying is a process of graphically combining video signals. It originally was developed in the television industry for the purpose of electronically imitating a filmic technique known as matting. In this context, the most conventional use has been to take two camera images and juxtapose them in a way which creates the illusion of a single, continuous three- dimensional space. Thus keyers are often referred to in terms of placing one image “behind” an object in a second image or of “inserting” an image “into” an area of another image. Using a keyer, you can create a shape in a first image, by defining the gray values that comprise that shape, and then remove all portions of the image within the boundary of that shape. Into that hole you can then insert the portions of a second image which spatially correspond if the two images were to be superimposed.

The development of a keyer as a three-input device, with voltage controllable parameters as well as its use in an image processing systems necessitates a broader understanding of the functions of a keyer.

#### How a Keyer Works

There are three channels in the luminance, or black and white, keyer: two main channels, A and B, and a clip input. Each of the main channels is a VCA or voltage controlled amplifier, which sends the incoming signal to the same electronic switch. At any given moment, this switch chooses either signal A or B at its output. The rate of switching is fast, taking place several times within each horizontal line of each frame. The video signal that is going into the clip input controls this switch. A clip level determines a certain threshold point, and the clip input signal is compared to the threshold. It is the voltage levels of the signals that are being compared. When displayed on the raster, these voltage levels become the gray levels of the image. The comparison is being made at each point on each horizontal line. When the voltage of the clip input signal exceeds this threshold point, and the signal is therefore brighter than a

predetermined gray level, channel A is presented at the output of the switch. When the voltage of the signal falls below the threshold, and is therefore darker than a certain gray level, channel B is seen. Moving the clip level control knob clockwise increases the threshold point. This allows more of B to be seen than A. Thus channels A and B will always be on opposite sides of the clip edge. A key reversal simply exchanges the positions of channel A and B relative to this threshold point.

#### Internal and External Keying

The conventional use of a keyer as a matte device is a specific case in which one of the two signals going into the VCAs is also being used as an input to the clip channel. This technique is often referred to as internal keying. Some keyers are hardwired in a way which allows internal keying only. When a third signal, separate from either of the VCA input signals is patched to the clip input, this is called external keying.

#### Wipes

Split-screens are a specific application of external keying. An externally synced oscillator is used as the clip input signal to switch between the two main channels. A continuous change in the threshold point, or clip level, from low voltage to high voltage, or vice versa, is often called a wipe.